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Predicting Language Outcomes at 4 Years of Age: Findings From Early Language in Victoria Study



WHAT'S KNOWN ON THIS SUBJECT: Children with language impairment have less-than-optimal outcomes later in childhood, in adolescence, and in adulthood. Little is known about early-life environmental, social, and family risk factors for language impairment at 4 years.



WHAT THIS STUDY ADDS: Family history of speech/language problems and low maternal education levels and socioeconomic status helped explain more variation in adverse language outcomes at 4 years than at 2 years, but ability to predict impairment remained limited.

abstract

OBJECTIVE: To quantify the contributions of child, family, and environmental predictors to language ability at 4 years.

METHODS: A longitudinal study was performed with a sample of 1910 infants recruited at 8 months in Melbourne, Australia. Predictors were child gender, prematurity, birth weight and order, multiple birth, socioeconomic status, maternal mental health, vocabulary, education, and age at child's birth, non-English-speaking background, and family history of speech/language difficulties. Outcomes were Clinical Evaluation of Language Fundamentals-Preschool, language scores, low language status (scores >1.25 SDs below the mean), and specific language impairment (SLI) (scores >1.25 SDs below the mean for children with normal nonverbal performance).

RESULTS: A total of 1596 children provided outcome data. Twelve baseline predictors explained 18.9% and 20.9% of the variation in receptive and expressive scores, respectively, increasing to 23.6% and 30.4% with the addition of late talking status at age 2. A total of 20.6% of children (324 of 1573 children) met the criteria for low language status and 17.2% (251 of 1462 children) for SLI. Family history of speech/language problems and low maternal education levels and socioeconomic status predicted adverse language outcomes. The combined predictors discriminated only moderately between children with and without low language levels or SLIs (area under the curve: 0.72–0.76); this improved with the addition of late talking status (area under the curve: 0.78–0.84).

CONCLUSIONS: Measures of social disadvantage helped explain more variation in outcomes at 4 years than at 2 years, but ability to predict low language status and SLI status remained limited. *Pediatrics* 2010;126:e1530–e1537

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KEY WORDS

low language, specific language impairment, risk factors, longitudinal study, child, preschool

ABBREVIATIONS

SLI—specific language impairment

ELVS—Early Language in Victoria Study

LGA—local government area

SES—socioeconomic status

NESB—non-English-speaking background

OR—odds ratio

AUC—area under the curve

K-BIT2—Kaufman Brief Intelligence Test, Second Edition

CELF-P2—Clinical Evaluation of Language Fundamentals-Preschool, Second Edition

SEIFA—Socio-Economic Indexes for Areas

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Early language development is considered the foundation for later educational and academic achievement and is important for social adaptation. Children with language impairment experience outcomes that are less than optimal, including poorer reading, spelling, and math skills and increased emotional and behavioral difficulties.^{1–5} Young people with persistent impairments are more likely to not be in education, employment, or training,² and those employed are more likely to be in semi-skilled or unskilled jobs.⁶ Adults report social isolation and anxiety, particularly regarding situations that are communicatively demanding.⁷

A major challenge regards how and when best to intervene to reduce morbidity and to improve outcomes; this requires a much better understanding of the natural history of language delay than is currently available. As highlighted in a major 2006 US Preventive Services Task Force systematic review,⁸ neither screening nor directly assessing the communication skills of very young children has proved particularly helpful at the population level, because of time requirements, costs, and poor sensitivity and specificity of existing language screens. Up to 20% of 2-year-old children have delayed expressive language,^{9,10} which resolves by 4 to 5 years of age in ~50% to 60% of cases^{11,12}; conversely, not all affected 4-year-old children have a history of early language delays. Therefore, it is not yet possible to predict accurately the trajectory that individual children or groups may follow.

Another approach is the elucidation of risk factors that predict accurately the development of persistent language delays. The US Preventive Services Task Force recommended prospective research to quantify the predictive strength of risk factors in screening for speech and language delays, and it identified a range of child, family, and

maternal factors worthy of exploration in high-quality, epidemiological, longitudinal studies.⁸ Two subsequent, community-based studies^{9,10} indicated that their contributions are small when children are very young. In our own research,⁹ male gender and a family history of speech and language problems did predict low expressive vocabulary levels at 2 years of age. The regression models explained just 4% of the language outcome, however, and most of the risk factors postulated by the task force, including socioeconomic status (SES), maternal mental health, and maternal vocabulary, showed inconsistent or no associations. Earlier communication skills (eg, at 12 months) were much more strongly predictive of vocabulary at 2 years but, even with the earlier communication scores included, four-fifths of the variation remained unexplained.

It is possible that the importance of these factors increases as children become older.^{9,13} In other words, factors identifiable during infancy and toddlerhood might predict language delay that is not yet evident at age 2, thus offering opportunities for truly preventive interventions to very young children on the basis of risk.¹⁴ This would be congruent with current models positing lifelong impacts of cumulative disadvantage (JM Nicholson, N Lucas, D Berthelsen, M Wake, unpublished data, 2009).

Within the larger group of children whose language scores are low is the smaller subgroup with specific language impairment (SLI), whose low language levels are coupled with normal nonverbal skills.¹⁵ SLI traditionally has been viewed as a “pure” disorder¹⁶ or primary deficit of language, but it now seems that children with SLIs may not be as clearly distinguishable as once thought.^{17,18} This may reflect in part the arbitrariness of the verbal and nonverbal cutoff points used to de-

termine SLI status, because many children demonstrate results either just above or just below the cutoff points although their profiles are similar.³ Therefore, it is also possible that the determinants of SLI status are similar to the determinants of low language status.

This article focuses on a large community cohort of 4-year-old children, building on our previous reports at 12 and 24 months.^{9,13} We speculated that, by 4 years of age, environmental, social, and family factors would be increasingly important to language outcomes, in combination with early communication and vocabulary development. The aims of this study were to quantify the contribution of putative early-life risk factors in a large community cohort to the following outcomes: (1) receptive and expressive language scores on a standardized language assessment, (2) low language status, and (3) SLI status (ie, low language status within the subgroup of children with normal nonverbal performance) at age 4. The additional contribution of low expressive vocabulary status at age 2 to these outcomes also was quantified.

METHODS

Sampling and Participants

The Early Language in Victoria Study (ELVS) commenced in 2002.^{9,13,19} A community sample of 1910 infants 7.5 to 10.0 months of age was recruited between September 2003 and April 2004 from 6 local government areas (LGAs) in metropolitan Melbourne (population of 3.9 million in 2008) in the state of Victoria, Australia. The LGAs were selected by stratifying Melbourne's 31 LGAs into 3 tiers according to the Australian Census-based Socio-Economic Indexes for Areas (SEIFA) Index for Relative Socio-Economic Disadvantage (representing attributes such as low income, low educational attainment,

and high unemployment levels)²⁰ and then selecting 2 noncontiguous LGAs from each tertile category.

Recruitment was through the Victorian Maternal and Child Health Service, a universal nursing service for families with children 0 to 6 years of age, supplemented by the hearing screening sessions offered at that time to all 7- to 9-month-old infants and by local newspaper publicity. Children with serious disabilities or developmental delays (eg, Down syndrome) were excluded, as were parents who did not speak and/or understand English; we attempted, however, to maximize participation by designing questionnaires at a reading level of no more than grade 6.

Figure 1 shows retention across the first 5 waves of the study. This article draws on parent-reported characteristics of the child, family, and mother at 8 and 12 months, parent-reported data on the child's expressive vocabulary at 24 months, and measured language outcomes at 4 years. The analyzed sample comprised the 1596 participants who provided language data at 4 years. All parents provided written, informed consent.

Measures

Risk Factors

Ten of our 12 risk factors were identified by the 2006 US Preventive Services Task Force review examining predictors of speech and language delays in preschool-aged children,⁸ that is, male gender, perinatal factors (twin birth, preterm birth, and birth weight), minority status, SES, birth order, family history of speech and language problems, parental education, and maternal age. For reasons described previously,⁹ we also included maternal mental health status and vocabulary score, on the basis of hypothesized associations with language development in the preschool years. Table 1 shows the 12 potential predictors, which are

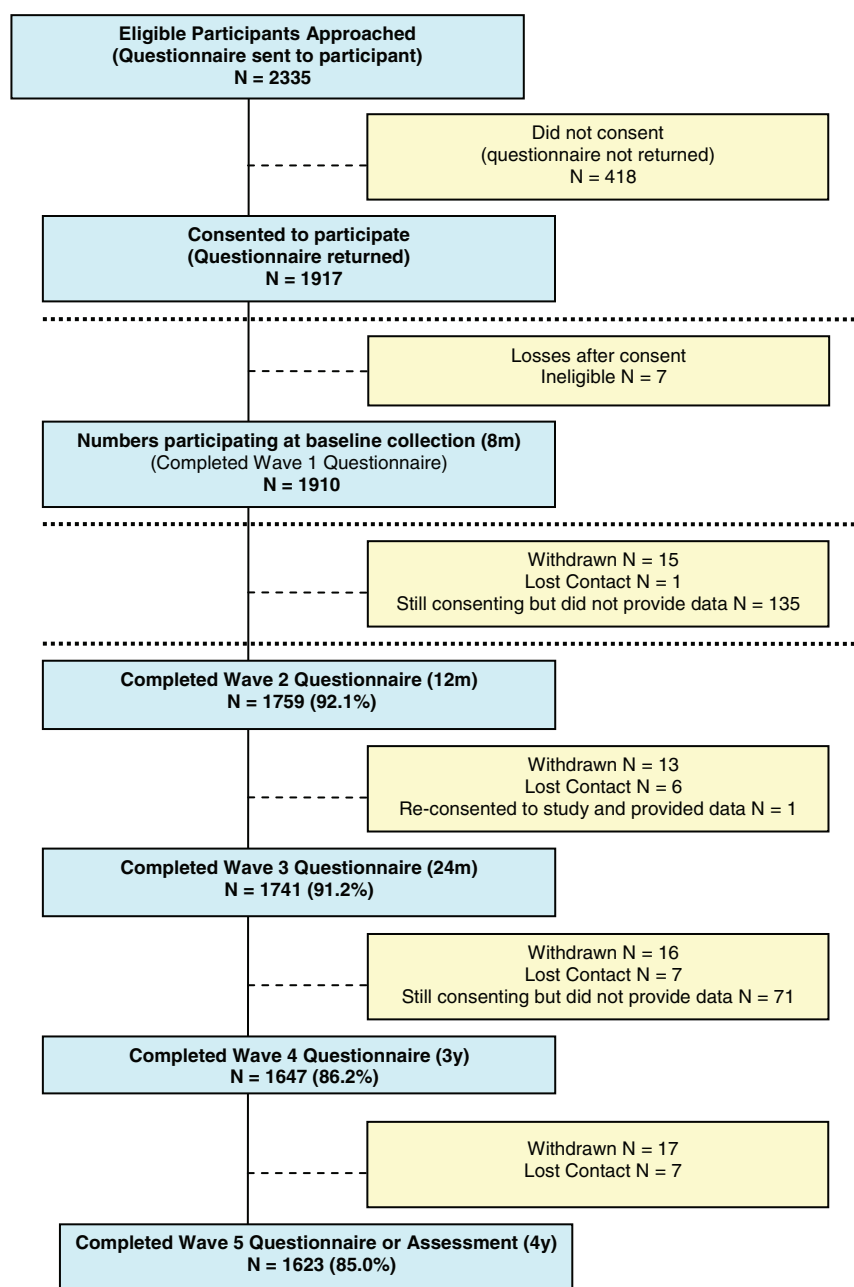


FIGURE 1

Flowchart for ELVS participants from baseline (8 months) to 4 years.

the same as those reported when the children in the ELVS were 2 of age.⁹

Minority status was indicated by non-English-speaking background (NESB). Such children typically live in families that have migrated to Australia relatively recently, from any of >100 countries. English is not the main language spoken to the child at home,⁹ and a NESB is in part an indicator of the

language-learning environment. SES was measured by using the SEIFA Index of Relative Disadvantage²⁰ at the level of Census collection district (the smallest geographic unit for which SEIFA scores are available). SEIFA scores are standardized for the Australian population to a mean \pm SD of 1000 ± 100 , with higher scores indicating greater advantage. Maternal mental health

TABLE 1 Baseline (8-Month) Characteristics of Children Participating and Lost to Follow-up at Age 4

Baseline Characteristics	Did Not Participate at 4 y (N = 314) ^a	Participated at 4 y (N = 1596) ^b
Female, %	53.8	48.6
Twin birth, %	2.9	2.8
Preterm birth (<36 wk), %	2.5	3.2
Birth weight, mean \pm SD, kg	3.4 \pm 0.5	3.4 \pm 0.5
Birth order, %		
First	50.3	50.1
Second	35.7	35.3
Third	10.4	12.2
Fourth	3.6	2.5
NESB, %	12.4	5.5
Maternal education level, %		
\leq 12 y	31.7	21.0
13 y	36.6	40.8
Degree/postgraduate degree	31.7	38.1
SEIFA score, mean \pm SD	1023 \pm 70	1039 \pm 58
Family history of speech/language difficulties, %	23.6	25.1
Maternal mental health problem, %	31.5	31.7
Maternal vocabulary score, mean \pm SD	26.0 \pm 6.0	27.7 \pm 4.9
Maternal age at birth of child, mean \pm SD, y	30.3 \pm 5.2	31.3 \pm 4.4

Participants provided CELF-P2 outcome data for \geq 1 of receptive and expressive scales.

^a Sample sizes ranged from 232 to 314.

^b Sample sizes ranged from 1519 to 1596.

was measured with the Nonspecific Psychological Distress Scale,²¹ dichotomized as “likely mental health problem” (score of \geq 4 of a possible 24) versus “no mental health problem” (score of $<$ 4). Maternal vocabulary was measured by using the written, 44-item, multiple-choice, modified version of the Mill Hill Vocabulary Scale,²² with correct answers tallied to provide a raw quantitative score (maximal possible score of 44).

Early Language Measure

At 24 months of age, parents completed the words and sentences version of the MacArthur-Bates Communicative Development Inventory.²³ The authors gave permission for substitution of 24 vocabulary items (eg, “foot-path” for “sidewalk”) to accommodate Australian usage. Raw (quantitative) scores were calculated for vocabulary production, and children were classified as late talkers if their scores were in $<$ 10th percentile on the basis of gender-specific normative values ($<$ 119 words for girls and $<$ 79 words for boys).²³

Outcomes

Trained research assistants individually assessed each child by using the Australian adaptation of the Clinical Evaluation of Language Fundamentals-Preschool, Second Edition (CELF-P2).²⁴ This yields 2 standardized scales, each with a mean of 100 and a SD of 15, that is, receptive (sentence structure, concepts and following directions, and basic concepts subtests) and expressive (word structure, expressive vocabulary, and recalling sentences subtests). The matrices subtest of the Kaufman Brief Intelligence Test, Second Edition (K-BIT2),²⁵ provided an estimate of nonverbal cognitive abilities. Children were assessed mainly in their local community child health centers, although some assessments were performed in the children’s homes, if that was more convenient for the families. Low language was defined on the basis of scores on the CELF-P2 receptive or expressive composites that were $>$ 1.25 SDs below the mean (ie, \leq 81) for the normative population. This was in accordance with cutoff points

adopted in previous epidemiological studies.^{2,3,15} SLI status was defined only for the subgroup of children with K-BIT2 matrices subtest scores within the average range. Children were classified as having SLIs if their CELF-P2 scores were $>$ 1.25 SDs below the mean. The average range for K-BIT2 scores was defined as values not more than 1.25 SDs below the ELVS mean; the internal cutoff point was used because the US normative sample included only 100 children 4 years of age.²⁵ This meant that children were excluded from the SLI analyses if they scored \leq 86 on the K-BIT2. We also excluded children with NESBs and those whose parents reported that they had been diagnosed with autism spectrum disorder or a permanent hearing problem.¹⁸

Analyses

Multivariate linear regression models were fitted to the CELF-P2 scores (aim 1), and the coefficient of determination (R^2) was reported to quantify explained variation. Multivariate logistic regression models were fitted to the binary outcomes of low language status (aim 2) and SLI status (aim 3). The area under the curve (AUC) was reported to quantify the combined ability of the predictors to discriminate between children with and without low language (or SLI). We emphasize that the AUC is being used here purely to discriminate the groups for the binary outcomes and this interpretation is statistically valid. AUC values of 0.5 and 1 indicate chance discrimination and perfect discrimination, respectively,²⁶ values between 0.7 and 0.8 indicate moderate discrimination, and values between 0.8 and 0.9 indicate good discrimination.²⁷ All 12 baseline predictors were included for aims 1 and 2 but only 10 were included in the SLI analyses, because children with NESBs were excluded from the SLI classification and there were no twin births in the remaining sample. For each aim, the

regression analyses were then performed again with the inclusion of late talking status at 2 years of age as an additional predictor. Analyses were implemented by using Stata 10.1 (Stata Corp, College Station, TX).

RESULTS

Figure 1 illustrates the participant flow across the 5 waves, and Table 1 compares characteristics of those who were and were not assessed at age 4. Differences between children participating ($N = 1596$) and not participating ($N = 314$) in the ELVS at 4 years were modest, with nonparticipants, as expected, being slightly less advantaged in terms of NESB and maternal education, SES, and vocabulary scores.

The mean CELF-P2 receptive and expressive composite scores were 96.7 (SD: 14.9) and 99.6 (SD: 15.1), respectively. The mean K-BIT2 matrices subtest score was 104.2 (SD: 13.4; range: 55–146; $N = 1592$); 150 children (9.4%) scored >1.25 SDs below the mean. Another 13 children were excluded from the analyses of SLI status because of an autism spectrum disorder (11 children) or a hearing problem (2 children). These diagnoses were made known to the team either through parent-completed questionnaires in previous waves or when parents telephoned the study coordinator to inform her of the diagnosis.

In the linear regression analyses examining CELF-P2 scores (aim 1), the 12 baseline predictors accounted for 18.9% and 20.9% of the variation in the receptive and expressive scores, respectively (Table 2), which increased to 23.6% and 30.4%, respectively, when late talking status at 2 years of age was added. Nine of the 12 factors (ie, all except twin birth, preterm birth, and maternal mental health problems) were associated with both language scores at the 5% level of significance.

TABLE 2 Multivariate Linear Regression Analyses of CELF-P2 Standardized Scores With Respect to Potential Baseline Predictors

Predictor	Receptive ($N = 1473$) ^a		Expressive ($N = 1442$) ^b	
	Coefficient (95% CI)	<i>P</i>	Coefficient (95% CI)	<i>P</i>
Child				
Male	−4.6 (−6.0 to −3.2)	<.001	−2.9 (−4.3 to −1.5)	<.001
Twin birth	0.1 (−4.4 to 4.6)	.96	−0.9 (−5.4 to 3.6)	.69
Preterm birth (<36 wk)	2.9 (−1.6 to 7.4)	.20	1.6 (−2.9 to 6.0)	.49
Birth weight	2.0 (0.5 to 3.5)	.01	1.7 (0.3 to 3.2)	.02
Birth order (reference: first child)		.003		<.001
Second child	−0.6 (−2.2 to 1.0)		−1.6 (−3.2 to −0.02)	
Third child	−2.9 (−5.2 to −0.7)		−6.5 (−8.8 to −4.2)	
Fourth child	−7.3 (−11.9 to −2.6)		−8.8 (−13.4 to −4.2)	
Family				
NESB	−11.9 (−15.4 to −8.5)	<.001	−12.6 (−16.1 to −9.2)	<.001
SEIFA disadvantage, per 100-unit increase in scores	2.7 (1.5 to 4.0)	<.001	2.5 (1.3 to 3.8)	<.001
Family history of speech/language difficulties	−3.3 (−4.9 to −1.6)	<.001	−3.8 (−5.4 to −2.2)	<.001
Mother				
Education level (reference: ≤ 12 y)		<.001		<.001
13 y (completed school)	1.1 (−0.8 to 3.0)		1.4 (−0.5 to 3.3)	
Degree/postgraduate degree	4.8 (2.8 to 6.8)		4.1 (2.2 to 6.1)	
Mental health problem	−0.36 (−1.8 to 1.1)	.64	−0.37 (−1.9 to 1.1)	.63
Vocabulary score	0.48 (0.32 to 0.65)	<.001	0.62 (0.46 to 0.78)	<.001
Age at birth of child	0.21 (0.03 to 0.39)	.02	0.22 (0.04 to 0.40)	.02

CI indicates confidence interval.

^a $R^2 = 18.9\%$; R^2 increases to 23.6% with the addition of late talking status. The regression coefficient for late talking status was −9.5 (95% confidence interval: −11.2 to −7.7; $P < 0.001$; $N = 1395$ for this analysis).

^b $R^2 = 20.9\%$; R^2 increases to 30.4% with the addition of late talking status. The regression coefficient for late talking status was −12.9 (95% confidence interval: −14.6 to −11.1; $P < .001$; $N = 1365$ for this analysis).

Mean CELF-P2 receptive and expressive scores were lower for boys (4.6 units) than for girls (2.9 units) and higher for children whose mothers had a degree (4.8 units) compared to children whose mothers had not completed school (4.1 units). For every 100-unit increase in SEIFA scores, the CELF-P2 receptive and expressive scores increased by 2.7 and 2.5 units, respectively. When late talking status at 2 years was added as a predictor, the results indicated that children with low vocabulary scores at age 2 had mean receptive scores 9.5 units and expressive scores 12.9 units lower than those of their counterparts.

A total of 20.6% of children (324 of 1573 children) had low language results for ≥ 1 of the receptive (261 [16.4%] of 1595 children) and expressive (205 [13.1%] of 1560 children) composite scores. Table 3 (addressing aims 2 and 3) shows that 7 of the potential predic-

tors (male gender, birth weight, NESB, maternal education, maternal vocabulary, SEIFA disadvantage score, and family history of speech/language difficulties) were associated with low receptive and expressive language levels at the 5% level of significance. Most strikingly, NESB had a strong association with low expressive language status (odds ratio [OR]: 7.0) and a smaller (although still large) association with low receptive language status (OR: 3.0).

A total of 17.2% (251 of 1462) of children met the criterion for SLI for ≥ 1 of the receptive (138 [10.1%] of 1360 children) and expressive (106 [8.0%] of 1332) modalities. Table 3 shows that, compared with the low language status outcome, fewer predictors were associated with receptive (male gender, maternal education, SES, family history of speech and language problems, and maternal vocabulary) and

TABLE 3 Multivariate Logistic Regression Analysis of Low Language Status and SLI Status

Predictor	Low Language Status ^a				SLI Status ^b			
	Receptive (N = 1473)		Expressive (N = 1442)		Receptive (N = 1269)		Expressive (N = 1215)	
	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P
Child								
Male	2.29 (1.66–3.15)	<.001	1.90 (1.32–2.72)	.001	2.20 (1.46–3.32)	<.001	1.43 (0.90–2.28)	.13
Twin birth ^c	1.37 (0.54–3.45)	.51	0.32 (0.07–1.48)	.15	1.34 (0.36–4.98)	.66		
Preterm birth (<36 wk)	0.65 (0.25–1.69)	.38	0.55 (0.18–1.65)	.29	0.98 (0.32–3.03)	.97	0.65 (0.16–2.64)	.55
Birth weight	0.67 (0.49–0.94)	.02	0.52 (0.36–0.76)	.001	0.82 (0.53–1.26)	.37	0.62 (0.37–1.02)	.06
Birth order (reference: first child)		.11		.09		.16		.25
Second child	1.20 (0.84–1.70)		1.22 (0.81–1.83)		1.01 (0.63–1.61)		1.29 (0.75–2.21)	
Third child	1.50 (0.93–2.42)		1.75 (1.03–2.96)		1.88 (1.04–3.37)		2.00 (1.01–3.96)	
Fourth child	2.47 (1.06–5.74)		2.36 (0.93–5.97)		1.30 (0.36–4.75)		1.66 (0.43–6.34)	
Family								
NESB	2.97 (1.62–5.43)	<.001	6.96 (3.75–12.89)	<.001				
SEIFA disadvantage, per 100-unit increase in scores	0.71 (0.56–0.90)	.006	0.70 (0.54–0.92)	.01	0.70 (0.51–0.97)	.03	0.65 (0.45–0.92)	.02
Family history of speech/language difficulties	1.84 (1.32–2.56)	<.001	1.82 (1.25–2.65)	.002	1.88 (1.23–2.85)	.003	1.69 (1.05–2.73)	.03
Mother								
Education level (reference: ≤12 y)		.03		<.001		.03		<.001
13 y	1.16 (0.79–1.70)		0.60 (0.40–0.91)		0.95 (0.59–1.53)		0.50 (0.30–0.84)	
Degree/postgraduate degree	0.70 (0.45–1.10)		0.36 (0.22–0.59)		0.51 (0.28–0.91)		0.26 (0.14–0.51)	
Mental health problem	1.00 (0.72–1.38)	.98	0.83 (0.57–1.22)	.34	0.90 (0.58–1.38)	.62	0.77 (0.46–1.29)	.33
Vocabulary score	0.91 (0.88–0.95)	<.001	0.95 (0.92–0.99)	.02	0.92 (0.88–0.97)	.001	0.96 (0.91–1.02)	.16
Age at birth of child	0.99 (0.95–1.03)	.61	1.00 (0.96–1.04)	.91	0.97 (0.92–1.02)	.24	0.98 (0.92–1.03)	.43

CI indicates confidence interval.

^a Analysis included all children.^b Analysis included the subgroup of children with normal nonverbal performance scores who did not have NESBs, autism spectrum disorder, or hearing problems.^c The twin birth variable was not included in the analysis of expressive SLI status because all nonmissing children for this analysis were singletons.

expressive (maternal education, SES, and family history of speech and language problems) SLI at the 5% level of significance. The ORs for low language status and SLI status were generally similar in magnitude, however.

Table 4 summarizes how well the predictor variables discriminate between participants with and without low language status and SLI. Most of the AUC values were between 0.7 and 0.8, which suggests that, overall, the models provided moderate discrimination.²⁶ These increased to a good level of discrimination, most notably for expressive language, when late talking status at 2 years was added to the models, as might be expected. Models that included only the significant predictors (gender, birth weight, maternal education, SEIFA scores, family history, maternal vocabulary, and, for low language, NESB) provided nearly identical AUC values, compared with models that included all 12 potential risk factors.

TABLE 4 Summary of Accuracy of Predictors in Logistic Regression Models for Discriminating Between Children With and Without Low Language Levels and SLIs

Outcome	AUC (95% CI)
For models with baseline predictors only	
Low language	
Receptive	0.74 (0.70–0.77)
Expressive	0.76 (0.72–0.80)
SLI	
Receptive	0.72 (0.67–0.77)
Expressive	0.72 (0.67–0.78)
For models with baseline predictors and late-talking status	
Low language	
Receptive	0.78 (0.75–0.82)
Expressive	0.83 (0.79–0.87)
SLI	
Receptive	0.78 (0.74–0.82)
Expressive	0.84 (0.80–0.89)

CI indicates confidence interval.

DISCUSSION

Early child, family, and maternal factors explained one-fifth of the variation

in receptive (18.9%) and expressive (20.9%) language at 4 years of age (which was more than at age 2 for the same cohort, when they explained 4% and 7% of communication and expressive vocabulary outcomes, respectively⁹), and this increased further with the addition of late talking status. Although findings were essentially consistent across the 3 main outcomes, the number of risk factors that reached statistical significance decreased from 9 for continuous language scores to 7 for low language status, 5 for receptive SLI, and 3 for expressive SLI. It seems that, as language develops and can be measured more reliably, a mixture of biological and environmental factors becomes more important. Collectively, the predictors showed moderate discrimination between children with and without low language status or SLI, but the addition of late talking status to the models increased the ability to dis-

criminate, particularly for the expressive modality.

Environmental and genetic influences both seemed important. Socioeconomic disadvantage and low levels of maternal education were associated with all our 4-year language outcomes, with low maternal vocabulary levels (a marker of both disadvantage and cognitive abilities) predicting all except expressive SLI status. Social disadvantage has long been linked to poorer child language outcomes and academic underachievement,²⁸ primarily because of the influence it exerts on the quantity and quality of language to which children are exposed in the home environment.^{29,30} Reported family history of speech and language problems was a consistently strong biological predictor of early communication skills,¹⁵ vocabulary development at 2 years,^{9,19} and the language outcomes we measured at 4 years. Our findings regarding children from NESBs from the analysis of low language status are consistent with previous research that demonstrated that receptive skills in English are stronger than expressive skills.³¹ The increased risk of low language status associated with a NESB reflects the English-only language assessment protocol used in the ELVS.

In contrast, child factors (with the exception of gender) were less-consistent predictors of language at 4 years, as well as communication skills or vocabulary development at earlier ages. The association of lower birth weight, but not prematurity, with low language status but not SLI status suggests that, if causal, this effect may be

related more to social disadvantage and/or an adverse prenatal environment than to genetic factors. In line with other reports,²⁸ first-born children had higher CELF-P2 scores, which suggests an environment that is more enriched than that siblings might experience.

The strengths of the ELVS include its longitudinal, community-based design, with prospective, repeated measurement from infancy of communication, vocabulary, and language development. Attrition rates were low and, with minor differences, those assessed at age 4 were broadly representative of the recruited sample. Although the early waves were based solely on parent reports, we used the most-valid measures of communication and vocabulary available.⁸

CONCLUSIONS

Our findings suggest that the biological influences on language outcomes at 2 years of age⁹ are still strong at age 4 but social disadvantage becomes increasingly important, possibly through children's cumulative exposure to less-rich language environments. Earlier we posited that infants are equipped and primed to acquire very early language.^{9,10} Activation and acceleration rates may differ, however, and these new findings suggest that language development is vulnerable to further disruption by social disadvantage in the latter preschool years. Although sobering, this potentially offers a fairly prolonged window of early childhood during which these effects could be prevented, rather than simply ameliorated.

Our combined ability to predict which infants and toddlers will have persistently low language levels and/or persistent SLIs remains modest at best. Therefore, we recommend that early language-promotion activities be universal or targeted to broad groups of children on the basis of social disadvantage and/or low early communication levels. Early interventions should aim to enrich the home language environments of these children, thereby limiting the accumulated risk of exposure to adversity over time.

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